Spiral Growth of Colloidal Gold and Moiré Fringe

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$$E_B - RT\ \ln A = \Delta F^* - RT\ \ln K, \quad (2)$$

where ΔF^* is the free energy of activation for flow and K a constant which depends upon the shear stress, the temperature and the vibrational frequencies of the liquid molecules concerned. Though neithcr ΔF^* and K can be evaluated directly, the left side of the relation (2) can be estimated experimentally and it may give the measure relative to ΔF^*. It was shown that the linear relations between $\log V_B$ and $1/T$ shift according to values of $(E_B - RT\ \ln A)$ at a certain temperature which depends upon the composition of the asphalts used.

Effects of colloidally fine fillers on the flow properties of asphalts were observed. It was found that carbon black reduces V_B remarkably in comparison with colloidal silica and calcium carbonate.

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Eiji SUITO and Natsu UYEDA

Nature, 185, 453 (1960)

Various growth spirals and related matters recently observed by electron microscopy on lamellar single crystals of gold, prepared colloid-chemically under definite conditions as discussed in previous papers.

A small hole exists at the centre of the spiral, from where the ridge line starts and, after passing on the outer perimeter of the crystal, come back to the initial starting point. The two spirals on both surfaces of a crystal are nearly symmetrical to each other in most of the present examples.

In the dark-field image, formed with the $(2\bar{2}0)$ reflexion there appeared nearly parallel thick moir'e fringes, the direction of which is again parallel to $[2\bar{2}0]$ axis of the crystal. This means that they were formed by the interaction of two electron beams reflected respectively by each $(2\bar{2}0)$ plane contained in two superposed steps.

When the cause of the fringe is supposed to be attributable only to the slight azimuthal rotation of steps, the angle of rotation α is given by an equation: $\alpha = d_{2\bar{2}0}/D$, where D and $d_{2\bar{2}0}$ are the spacing of the moiré fringe and the interplanar spacing of the $(2\bar{2}0)$ plane. With the set of dark-field images, the angl α has been estimated to be of the order of 2×10^{-3} red. on an average. Further, it increases roughly linearly from 7×10^{-4} red. to 4×10^{-3} red. or to much larger values as the position on the step, where the spacing of the fringe was meaured, approaches the centre of the crystal along the spiral step.

As for the small hole, Frank has derived the relationship between the hole diameter (D_0) and the strength of the Burgers vector (b) at the core of the screw dislocation as follows, though slightly modified here:

$$b = 2\pi (S \cdot D_0/G)^{1/2} \quad (1)$$

where S and G are the surface free energy and modulus of rigidity of the material. The hole diameter is distributed over a range of 200–2400 A. and the most

1200 A, while the mean value becomes 1020 A. With this value, the stength of the Burgers vector was estimated to be 93–118 A, where 2.76×10^{11} dyne/cm^2. and 600–1,000 erg/cm. were adopted for G and S respectively. On the other hand, we have also estimated the step height to be 109 A on an average by the shadow-casting method. This is of quite the same order as the strength of Burgers vector above obtained.

The Measurement of Particle Size of Ultra Fine Powders by the Air Permeability Method

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Kogyo Kagaku Zasshi (Journal of the Chemical Society of Japan, Industrial Chemistry Section), **63**, 556 (1960)

The particle sizes of ultra fine powders ranging from 20 to 400 mμ have been measured by the air permeability of packed columns. As we leave the co-operative contributions of Poiseuille and Knudsen flows, two kinds of surface areas can be calculated by the application of a proper analytical method.

The experimental result suggests that the surface area deduced from the Poiseuille flow represents the geometric area of the secondary aggregated particles, while that deduced from the Knudsen flow is to be identified with the true surface area of the primary particles. The values of surface areas of various powders obtained from the Knudsen term agree with those calculated from electron microscopic data.

Spiral Growth of Lamellar Single Crystal of Crystal of Colloidal Gold

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Journal of Electronmicroscopy, **8**, 25 (1960)

The lamellar single crystal of colloidal gold, prepaed by the reduction of aqueous solution of auric chloride with salicylic acid at room temperature, sometimes shows a couple of growth spirals, which appear at the same time on two lamellar habit surfaces of a cystal. The three dimensional configuration of the crystal with spiral steps has been confirmed by the replica technique of the electron microscopy. A small hole can be observed at the centre of the spiral on most of the crystals having growth spirals. The equation presented by Frank giving the relationship between the Burgers vector and the diameter of such a hole has also been examined with respect to the crystal of colloidal gold.

A short discussion has also been made about the moiré fringes which appeared on the superimposed growth steps.